EnergyPulse

CCMSS&SE

CONVERGENCE OF CONVENTIONAL MANUFACTURING
SYSTEM TO SMART & SENSIBLE ENVIRONMENT

Case Study

Partners

EnergyPulse DOO (Serbia), a HW/SW solutions development organization, that also satisfies the R&D as well as training and consultancy needs of its clients, is a technology provider that developed IoT devices for advanced quantification of resource consumption in a decentralized manner on a micro level. DMD GmbH (Germany), is an experienced manufacturer in the metal-forming category, specialized in automotive and aerospace industries, with a focus on the production of machine parts and elements from one-piece prototypes to large-scale processing. The reason for participation in S4A program is the strive to improve and understand their processes better by implementing new technological trends and solutions in the form of IoT and AI, to establish predictive maintenance system and converge to a smart factory concept.

Case Study problem

DMD GmbH is interested to integrate smart solutions in its system with the aim to establish predictive maintenance for the machine tools to prevent downtime. Following a business recommendation, the partners agreed to act toward rising digitization level in terms of predictive maintenance by decision to convert DMD's manufacturing system into the living lab. The initiative was conceived in a way where EnergyPulse integrates several IoT solutions to empower manufacturing system with interconnected IoT nodes regarding energy consumption tracking, anomaly detection, event forensics, etc., with aim to enable transition of conventional manufacturing systems toward 4th industrial revolution production con-
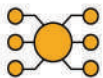
Work Plan

To ensure fruitful project realization EnergyPulse carried out the following actions:

- ▶ Technology adjustment for client needs
- ▶ Technology implementation
- ▶ Data acquisition and telemetry services setup
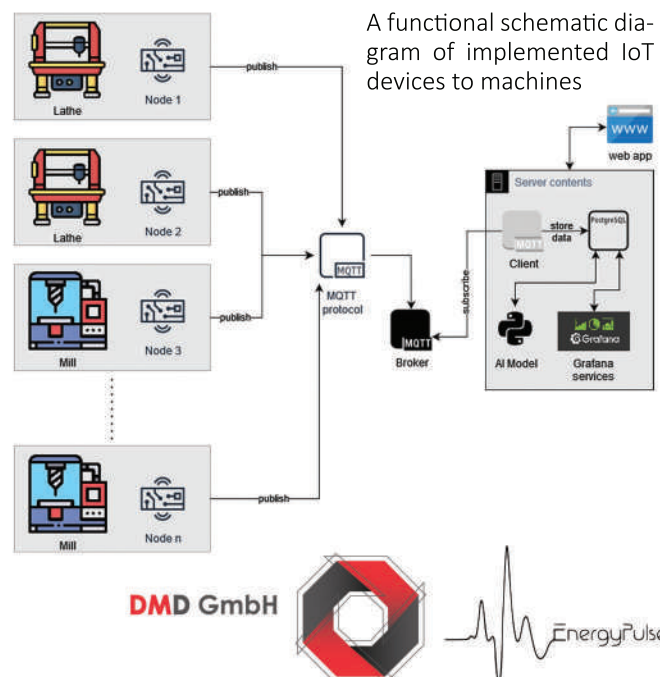- ▶ Data post processing and evaluation

Implemented IoT solutions

For the concrete case, EnergyPulse proposed the following solutions:

1. Current Profiler - IoT device for data acquisition on changes in electric current intensity and energy use

2. Thermal Cube - IoT device for acquisition of data on changes in temperature, pressure, relative humidity - thermodynamic

Knowledge Transfer description

EnergyPulse implemented noninvasive, scalable, flexible and customizable set of solutions in order to boost decision making within manufacturing, accompanied with increase in overall resource efficiency in a decentralized manner. EnergyPulse enabled DMD to benefit with the knowledge expansion in terms of complete event forensics and consumption quantification on observed processes/ machine operations as well as possibility to establish data-driven predictive maintenance system. The technology behind IoT nodes is based on CLEC principles and their role is to reveal in real time if the certain changes in machine operation stimulates energy efficiency. Upon behavior profile establishment an AI-based model is applied which opens the door to predictive maintenance by tracking the anomalies in the current and model-predicted machine behavior. As as its benefit, EnergyPulse recognizes potential business cooperation with partner and its connections on the EU market after successful realization of the project.

Time frame

The testing and data generation period took one month starting from 18th November to 19th December 2022.

A functional schematic diagram of implemented IoT devices to machines

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Current (A) Profiler

- Atlas Copco GA11 air compressor
- HITACHI SEIKI VM-40 II CNC VERTICAL MILL
- DECKEL MAHO DMU 50 EVO LINEAR
- Photovoltaic energy generation system

THERMAL CUBE

- Atlas Copco GA11 air compressor & Compressor room
- Office space

Machines specs

Hitachi Seiki VM-40 CNC Vertical Mill

Table Size: 30" X 16"
Max. Table Load: 771 LBS.
X-Axis Travel: 22"
Y-Axis Travel: 16"
Z-Axis Travel: 16"
Spindle Nose to Table: 7.9 to 24"
Cutting Feed: 197 IPM

Rapid Traverse: 590 IPM
Spindle Taper: #40
Spindle Speed: 6,000 RPM
Tool Capacity: 20 ATC
Main Motor: 7.5 HP
Equipped with:
Seicos Multi II CNC Control

DECKEL MAHO DMU 50 EVO LINEAR

X-travel 500 mm
Y-travel 450 mm
Z-travel 400 mm
Travel B 0-161°
Travel C 360°
Working Area 500x380 mm
Spindle Type HSK 63

Spindle Range 0-18000 rpm
Tools Pocket   30
Feed   0-20000 mm / min
Rapid Axis X 80
Rapid Axis Y 50
Rapid Axis Z 50
Weight   6000 Kg

Project results

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Datasets
for development of AI model to prevent downtime (based on electrical currents, power, energy, temperatures, relative humidity, pressure)
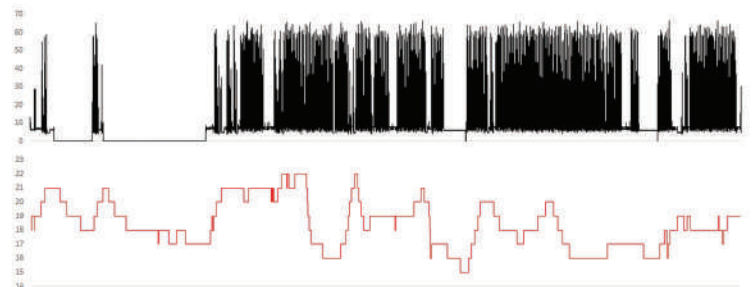
75.5 Million

Data samples
for understanding machine operation behavior and quantification of energy consumption

1

Contract signed
with DMD for future business collaboration

Client benefits

✓ **Manufacturing downtime prevention**
(Dynamic KPI's establishment & Complete event forensics)

✓ **Cost reduction & Productivity increase**
(This technological update ensures a reduction of energy consumption and GHG emissions in the range of 10-30% with 20% increase in productivity)

✓ **Machine energy consumption quantification**